

Attachment I

Preliminary 316(b) Technology Feasibility Review

Mount Tom Station

The information included in this attachment was taken primarily from the Mount Tom Station (MTS) Cooling Water Intake Structure (CWIS) Information Document, submitted to EPA on behalf of FirstLight Power Resources, LLC, in January of 2008. EPA is using the information included in the 2008 document to further the analysis and screening necessary to determine the best technology available to minimize the adverse environmental impacts from a CWIS that is site specific for MTS. The inclusion of estimated performance and cost information from FirstLight in this attachment does signify that EPA concurs with the information included in the 2008 report. EPA reserves the option to revise, amend or delete information included in this attachment as updated analyses are conducted.

1.0 Overview of Current MTS CWIS Characteristics

The intake structure at MTS consists of an 8.0 foot diameter pipe with 8.5 inch spaces between bars. This structure is approximately 30 feet into the river from shore, near the bottom, on inside curve of Connecticut River mainstem.

From November through April, the permit requires one pump operation, with a flow limit of 68.4 MGD (47,500 gpm). This results in an intake velocity of 2.1 fps at the river.

From May through October, the permit requires two pump operation, with a flow limit of 133.2 MGD (92,500 gpm). This results in an intake velocity of 4.1 fps at the river.

According to MTS Discharge Monitoring Reports from the year 2000 through 2004, the average water flow was 85.4 MGD.

An interior structure also makes up part of the CWIS. This site is approximately 350 feet away from the river bank, with an intake velocity of 1.6 fps at two 3/8 inch square traveling screen bays, each 10 feet wide by 13 feet deep.

The system that removes debris also transports fish off the traveling screens. The screen wash pump water has up to a 32 F delta T. The system washes off the traveling screens with 70 psi water pressure. Fish are subjected to a large vertical free-fall into a culvert and a 300 foot, partially uncovered, half-pipe conveys the fish the rest of the way to the river. Fish are subject to predation when in the half-pipe.

The electric fish barrier has been in operation since facility start-up (1960) to reduce impingement. An MTS study conducted at EPA's request in 2007 concluded that "the electric barrier is not effective at deterring fish from entering the intake".

2.0 Impingement

An Impingement Study was conducted from July 2006 – July 2008. This is a summary of the results:

- 85 fish impinged in first year
- 250 fish impinged in second year
- Based on continuous facility withdrawal
 - 572 fish estimated impinged in first year
 - 1,695 fish estimated impinged in second year
- Average yearly impingement estimate = 1,133 fish

Impingement was recorded in all months, with relatively high fish impingement numbers in December and March through April.

The species impinged included yellow perch, white sucker, spottail shiner, bluegill, gizzard shad, common shiner, Atlantic salmon. Impinged fish were predominantly, but not exclusively, resident species.

MTS determined overall impingement survival rate to be between 4 and 17%, depending on season. The study did not include the 300 foot transport to river in the evaluation.

3.0 Entrainment

A two year entrainment study is underway. One year is complete.

The preliminary data was reported as follows:

- Larvae in April (.1%), May, (38%), June (51%), July (11%) only - 8.9 million larvae*
- Eggs entrained in June / July only - yearly estimate ~ 58K eggs (< 1% of all ichthyo) *

* one year of raw sample values used to calculate MTS entrainment. Based on actual plant withdrawal data and assumes 100% mortality.

4.0 River / Withdrawal / Discharge Stats

MTS withdraws approximately 1.4 % of CT River annual mean flow (9,264 MGD).
MTS withdraws approximately 11.6% of CT River 7Q10 flow (1,147.2 MGD).

From November through April, the permit requires one pump operation, with a flow limit of 68.4 MGD (47,500 gpm). The maximum discharge temperature for this time period is 102 F and the maximum delta T is 32 F

From May through October, the permit requires two pump operation, with a flow limit of 133.2 MGD (92,500 gpm). The maximum discharge temperature for this time period is 102 F and the maximum delta T is 20 F

As an overview to the aquatic habitat of the Connecticut River, shortnose sturgeon issues (Federally Listed Species) Atlantic salmon issues (Essential Fish Habitat), and river herring/American shad decrease issues (anadromous species) all must be evaluated.

As a way to assess the relative amount of water withdrawn by MTS, the following information was assembled, based on a five year average of the Connecticut River discharge:

CT River Discharge	time span	% of CT River withdrawn by MTS
30,000 cfs (19,389 MGD)	April, May	- 0.4 – 0.7% withdrawn by MTS
20,000 cfs (12,926 MGD)	Nov, Dec, Jan	- 0.5% withdrawn by MTS
15,000 cfs (9,695 MGD)	June	- 1.4% withdrawn by MTS
9,000 cfs (5,817 MGD)	Feb, March	- 1.2% withdrawn by MTS
7,000 cfs (4,524 MGD)	October	- 2.9% withdrawn by MTS
5,000 cfs (3,232 MGD)	July, Aug	- 4.1% withdrawn by MTS
3,000 cfs (1,939MGD)	September	- 6.9% withdrawn by MTS

5.0 Technology Evaluation

The following technologies were evaluated to determine the degree to which they would be expected to minimize fish impingement and entrainment mortality at Mount Tom Station. The site-specific cost of each technology was also estimated.

5.1 Mechanical Draft Cooling Towers (MDCT)

MDCT are expected to reduce the volume of non-contact cooling water needed by approximately 97%. The intake velocity of the cooling water would be reduced to approximately 0.11 at the CWIS. The reduction in cooling water would likely result in a corresponding percent decrease in fish impingement and entrainment mortality of approximately 97%. The thermal plume would also be reduced by a large percentage. The exact percentage has not been determined.

The cost estimates are as follows:

\$58.4 million capital cost;
 \$ 4.0 million lost generation during construction;
 \$ 5.3 million annual O + M cost.

5.2 Natural Draft Cooling Towers (NDCT)

NDCTs are generally designed for facilities using non-contact cooling water at a rate of 200,000 gpm or greater. Since MTS uses less cooling water than this threshold (92,500 gpm), NDCTs are considered oversized in this site-specific case.

NDCT are also likely more expensive to construct than Mechanical Draft Cooling Towers (MDCT), for example, but no cost estimates are included at this time.

5.3 Use of Grey Water

Holyoke Water Pollution Control Facility (HWPCF) discharges up to 17 MGD and is 8.3 miles downstream of MTS. In theory, this facility could provide 13% of flow currently removed from the river by MTS. It is possible that using water from HWPCF could reduce intake velocity at the river intake point to 1.5 fps (Nov-April) and 3.5 fps (May – Oct).

While the MTS CWIS at the river would still have an approach velocity above 0.5 fps, the use of gray water would likely reduce impingement by approximately 13% from May through October and approximately 25% from Nov through April. Also, a likely reduction in entrainment of approximately 13% could be expected from May through October. The low entrainment rate projected from November through April would likely be unaffected.

One challenge facing this technology is the logistic difficulty related to the construction of a water transport pipe to connect the facilities. Also, the discharge of grey water at 102 F could increase the potential for additional primary productivity in the river in the vicinity of the MTS discharge.

No cost information is provided for the construction and operation of this technology.

5.4 Year Round Flow Reduction

The objective of this option is to reduce the amount of cooling water used at MTS by remaining at one pump operation (68.4 MGD) all year. This would result in a 47 % reduction in flow during the May through October time period. It is projected to reduce impingement and entrainment by approximately 47%.

The intake velocity at the river would remain at approximately 2.1 fps, well above 0.5 fps. The permitted delta T would increase to 32 F and the maximum discharge temperature would increase to 115 F for the months of May through October. The impact of the increased BTUs to the river during the warmer months would have to be evaluated.

The estimated operational cost of this option is \$4 million per year in lost revenue.

5.5 May and June Flow Reduction

The objective of this option is similar to Section 5.4, with the exception that one pump operation (68.4 MGD) is extended for the additional months of May and June only. According to the CT River 5 year flow average, July is expected to be lower flow month. This modification may reduce entrainment by approximately 42%, as May and June are large entrain months. Impingement, however, would only be reduced by approximately 1.6 - 5.7%

The lowest intake velocity at the river would still be approximately 2.1 fps, well above 0.5 fps. The permitted delta T would increase to 32 F and the maximum discharge temperature would increase to 115 F for the months of May and June. The impact of the increased BTUs to the river during these two additional months would have to be evaluated.

The estimated operational cost of this option is \$2 million per year in lost revenue. NOTE: This cost was estimated by EPA and must be verified by MTS.

5.6 Variable Speed Pump

MTS claims that the installation and use of variable speed pumps to control the rate of cooling water used at the facility will reduce the approach velocity of the CWIS and thus reduce impingement. In order for this to be an effective operational measure, the facility must have excess pump capacity under their current operation. The percentage of excess pump capacity at MTS for each month must be determined before a potential reduction in cooling water use and related impingement and entrainment impacts can be projected.

The estimated capital cost of this technology is \$800,000. Yearly operational costs were not included and must be presented.

5.7 Fish Return System Upgrade

In order to improve the current fish return system at MTS, the temperature of spray wash water must be reduced to ambient temperature. Also, the sluiceway must be covered and modified to reduce predation and improve fish transport to the river. This will increase the potential for survival of fish that are impinged.

While this modification would not directly decrease fish impingement, it may reduce impingement mortality by 40%. A site-specific impingement mortality study would have to be conducted at MTS once the improvements to the fish return system are completed to estimate the fish mortality reduction. The cost of this study must be included in the overall cost of the fish return upgrade.

This technology would provide no reduction in direct impingement and entrainment.

No cost information was provided for this upgrade. EPA estimated a capital cost of \$500,000. No operational cost was estimated. All cost estimates for this technology must be updated and presented.

5.8 Traveling Screen Upgrade

In addition to the improved sluiceway described in Section 5.7, Ristroph traveling screens shall also be installed and operated at the MTS CWIS. This technology would provide no reduction in direct impingement and entrainment. However, it may reduce impingement mortality by 40%. A site-specific impingement mortality study would have to be

conducted at MTS once the improvements to the fish return system are completed and the Ristroph traveling screens installed to estimate the fish impingement mortality reduction. The cost of this study must be included in the overall cost of the travelling screen upgrade.

The estimated capital cost of this technology is \$2 million. Operation and maintenance costs are estimated at \$144,000. The cost of the impingement mortality study must be included in the overall cost of this technology.

5.9 Barrier Net ^a

A barrier net approximately 172 feet long and 20 feet deep, with a 3/8 inch mesh pore size (9.5 millimeter) was evaluated. A low through-net velocity of 0.06 fps would be observed with a net of this size and pore size at MTS. Installation of this technology would involve construction and benthic disturbance in the Connecticut River in front of the CWIS. These impacts would have to be fully evaluated.

A reduction in impingement of 100% is estimated, but at the pore size indicated, no reduction in entrainment is expected.

The capital cost is estimated to be \$45,000 and the operation and maintenance cost was estimated to be \$101,000 per year.

The feasibility review of this technology must include a barrier net with a smaller pore size, able to also reduce entrainment. The dimensions of the net and the pore size must be presented and justified, along with expected capital costs and operation/maintenance costs per year.

5.10 Electric Fish Barrier

Based on the information submitted by MTS as part of their December 2008 Impingement Report, the electric fish barrier is not effective at reducing impingement or entrainment.

5.11 Cylindrical Wedge Wire Screens ^a

This technology involves the installation of three cylindrical screens in the river in front of the MTS CWIS. Each screen would be 6 feet in diameter and 20 feet long. The screen openings would be 3 millimeters. Installation of this technology would involve construction and benthic disturbance in the Connecticut River in front of the CWIS. These impacts would have to be fully evaluated.

The wedge wire screens as described here are expected to reduce impingement by 100%. Gauging the reduction in entrainment of Connecticut River ichthyoplankton by using wedge wire screens with a mesh size of 3 millimeters will require additional analysis.

Also, an analysis must be done to evaluate the mortality of ichthyoplankton that become lodged on the screen when their entrainment is blocked.

As a way to provide a comparison with other technologies in this document, EPA has estimated an entrainment reduction of 50% for the wedge wire screens described in this section.

Require openings of 0.5 to 1 mm for greater reduction, which were not evaluated by permittee

Much river debris is expected to clog intakes – increase O & M costs
Placing the intake(s) closer to the main channel of the river may increase the potential for overall entrainment and specifically anadromous species and shortnose sturgeon early life stage entrainment

\$ 7 million capital cost
\$ 2 million lost generation during construction
\$ 32K O & M cost per year

(NOTE: EPA would evaluate smaller openings and entrainment mortality issue with site-specific water body characteristics.)

5.12 Expanded Intake At River ^a

Reduce through-screen velocity to 0.5 fps
Incorporate Ristroph screens and improved fish return system
Reduce impingement by 80%
Reduce impingement mortality by 40%
No reduction in entrainment

\$ 6 million capital costs
\$ 6 million in lost generation during construction
O & M annual cost not provided

5.13 CWIS Relocation ^a

Kynard et al (2003) predicted that greater numbers of fish will likely be impinged if the CWIS at MTS is moved further away from the river bank and closer to the channel. The MTS CWIS is currently located at a bend in the river, far from the main channel.

Not considered as an option for BTA

^a MTS maintains that any construction in or near the river to expand the CWIS would cause adverse environmental impacts to the aquatic habitat of state endangered freshwater mussels and the federally protected shortnose sturgeon

6.0 Technology Analysis and Comparison

Based on the data submitted, the following potential technologies to reduce I & E were not evaluated further:

natural draft cooling towers, use of grey water, variable speed pumps, traveling screen upgrade, electric fish barrier, and CWIS relocation

The remaining technologies were compared in the tables and graphs below.

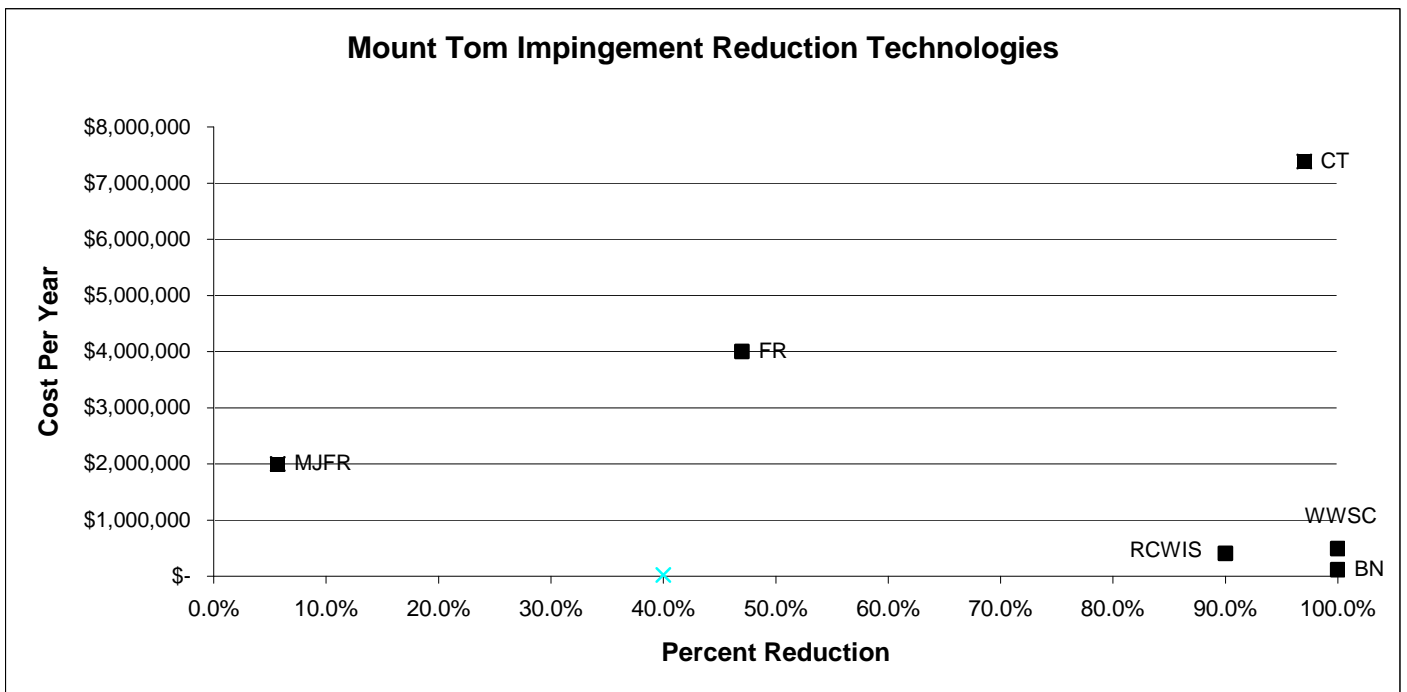
	Mount Tom Station Impingement Technologies				
	cost per year	yearly fish impingement	impingement reduction	# of fish survive per year	# of fish die per year
Mechanical Draft Cooling Towers	\$7,385,068	1,133	97.0%	1,099	34
Year round flow reduction	\$4,000,000	1,133	47.0%	533	600
May and June flow reduction	\$2,000,000	1,133	5.7%	65	1,068
Fish return system upgrade	\$21,735	1,133	40.0%	453	680
Barrier Net	\$115,175	1,133	100.0%	1,133	0
Wedgewire screen cylinders	\$488,576	1,133	100.0%	1,133	0
Expanded River CWIS	\$405,068	1,133	90.0%	1,020	113

	Mount Tom Station Entrainment Technologies				
	cost per year	yearly larval entrainment	entrainment reduction	larval survival per year	larval mortality per year
Mechanical Draft Cooling Towers	\$7,385,068	8,900,000	97.0%	8,633,000	267,000
Year round flow reduction	\$4,000,000	8,900,000	47.0%	4,183,000	4,717,000
May and June flow reduction	\$2,000,000	8,900,000	42.0%	3,738,000	5,162,000
Fish return system upgrade	\$21,735	8,900,000	0.0%	0	8,900,000
Barrier Net	\$115,175	8,900,000	0.0%	0	8,900,000
Wedgewire screen cylinders	\$488,576	8,900,000	50.0%	4,450,000	4,450,000
Expanded River CWIS	\$405,068	8,900,000	0.0%	0	8,900,000

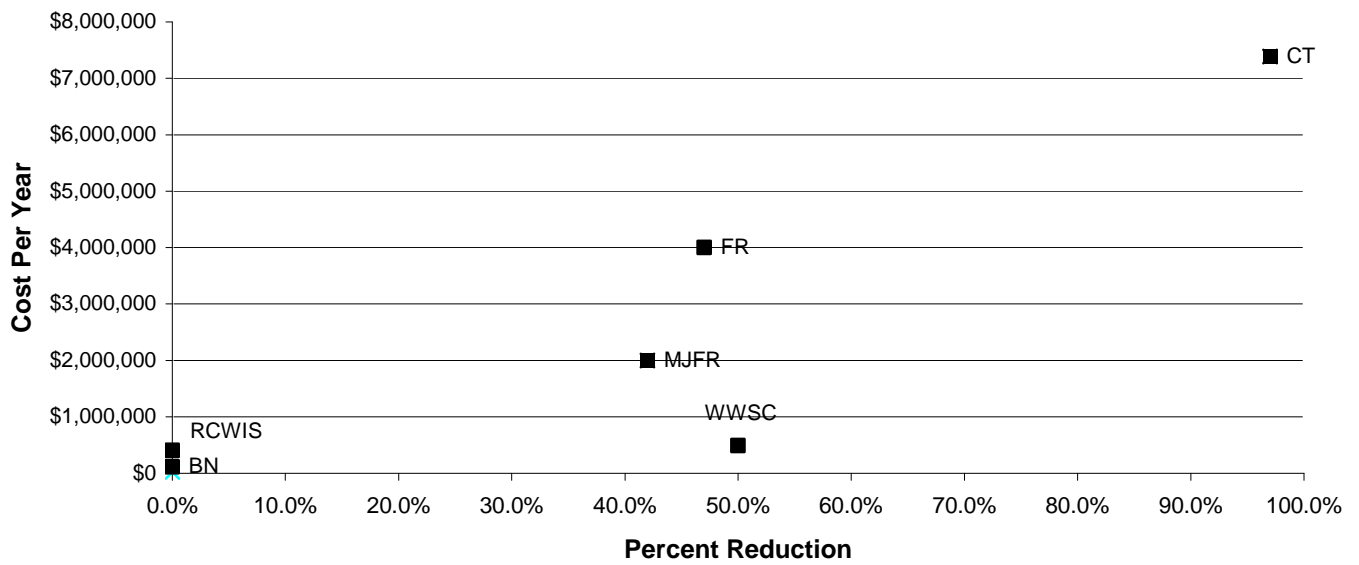
Costs were annualized over 30-year life of the cooling tower,. Assumes a discount rate of 7.6% pre-tax nominal value.

Costs were annualized over 20-year life of the cylindrical wedgewire screen intakes. Assumes a discount rate of 7.6% pre-tax nominal value.

Costs were annualized over a 9 year life of the barrier nets (net and two spares). Assumes a discount rate of 7.6% pre-tax nominal value.



Mount Tom Entrainment Reduction Technologies



CT	Mechanical Draft Cooling Towers
FR	Year round flow reduction
MJFR	May and June flow reduction
FRS	Fish return system upgrade
BN	Barrier Net
WWSC	Wedgewire screen cylinders
RCWIS	Expanded River CWIS